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Notes on the biology of *Pycnacantha tribulus*, another araneid without an orbweb (Araneae: Araneidae)

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Notes on the biology of *Pycnacantha tribulus*, another araneid without an orbweb (Araneae: Araneidae). - Observations on the nocturnal araneid *Pycnacantha tribulus* (Fabricius, 19781) in South Africa showed that both juveniles and adults do not spin orwebs. From a suspended U-shaped trapezium, they grasp their prey (moths) in flight. Aspects of the natural history of *P. tribulus* are described for the first time and its taxonomic relationships are discussed.

Key-words: Araneae – Araneidae – Pycnacantha – behaviour – Africa.

INTRODUCTION

The Lepidoptera, with more than 165 000 known species, form an important group of potential prey available to orbweb spiders. However, many moths escape from orbwebs because the scales on their wings stick to the adhesive silk threads, rendering the web ineffective (EISNER *et al.* 1964). ROBINSON & ROBINSON (1970) estimated that 54,3% Lepidoptera individuals are able to escape from the orbweb of *Argiope argentata* (Fabricius). In a small group of araneid spiders the orbweb has been adapted to better exploit this potential source of prey. STOWE (1986) discusses prey specialization in this group of araneids in detail.

Given that the orbweb is a primitive feature of the Araneidae (LEVI 1980), it appears that several groups within the family have evolved, in which the orbweb has been adapted, reduced or abandoned to increase the ability of the spider to utilize Lepidopteran prey. Adaptions to the orbweb consist mainly of the use of denser viscid threads (*Poltys* sp.) or changes in the shape of the web as found in the inverted ladder web of *Scoloderus cordatus* (Taczanowski) and the spanning-thread webs of *Poecilopachys* Simon and *Pasilobus* Simon (CLYNE 1973; STOWE 1986). These changes serve to increase the moth-capturing efficiency of the web (STOWE 1978).

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Web reduction results in the loss of prey-detection capabilities and the spider has to compensate for this in one way or another (CARICO 1978). Without the help of silk threads, the spider must develop a way to attract, detect and capture winged prey either by manipulating the reduced threads or by using a substance to attract prey. The bolas spiders of the subfamily Mastophorinae belong to this group of araneids where the "web" is actively whirled, by the legs during the prey-catching phase, to catch moths in flight with a viscid globule (STOWE 1986). Another stage of web reduction is found in *Celaenia* Thorell (FORSTER & FORSTER 1973), *Taczanowskia* Keyserling (EBERHARD 1981*b*) and *Kaira* O.P.-Cambridge (STOWE 1986), where silk threads are only used to support the spider rather than to be involved in the active catching phase. The front legs are used as a basket to grasp moths in flight. In several of these genera a substance that mimics the sex pheromones of female moths is emitted from glands on the front legs or supplied by giant adenocytes of the aggregate silk glands (LOPEZ 1987).

The present study reports on the African spider *Pycnacantha tribulus* (Fabricius). Brief observations on *Pycnacantha* were published by VAN VUUREN (1981) while FILMER (1991) erroneously inferred that they build small orbwebs. Most spiders that produce specialized webs are rare in collections. Known information are mainly based on Australian and South American spiders (MAIN 1982). Except for *Cladomelea akermanni* Hewitt (AKERMAN 1923) nothing is known of the rich African araneid fauna constructing specialized webs.

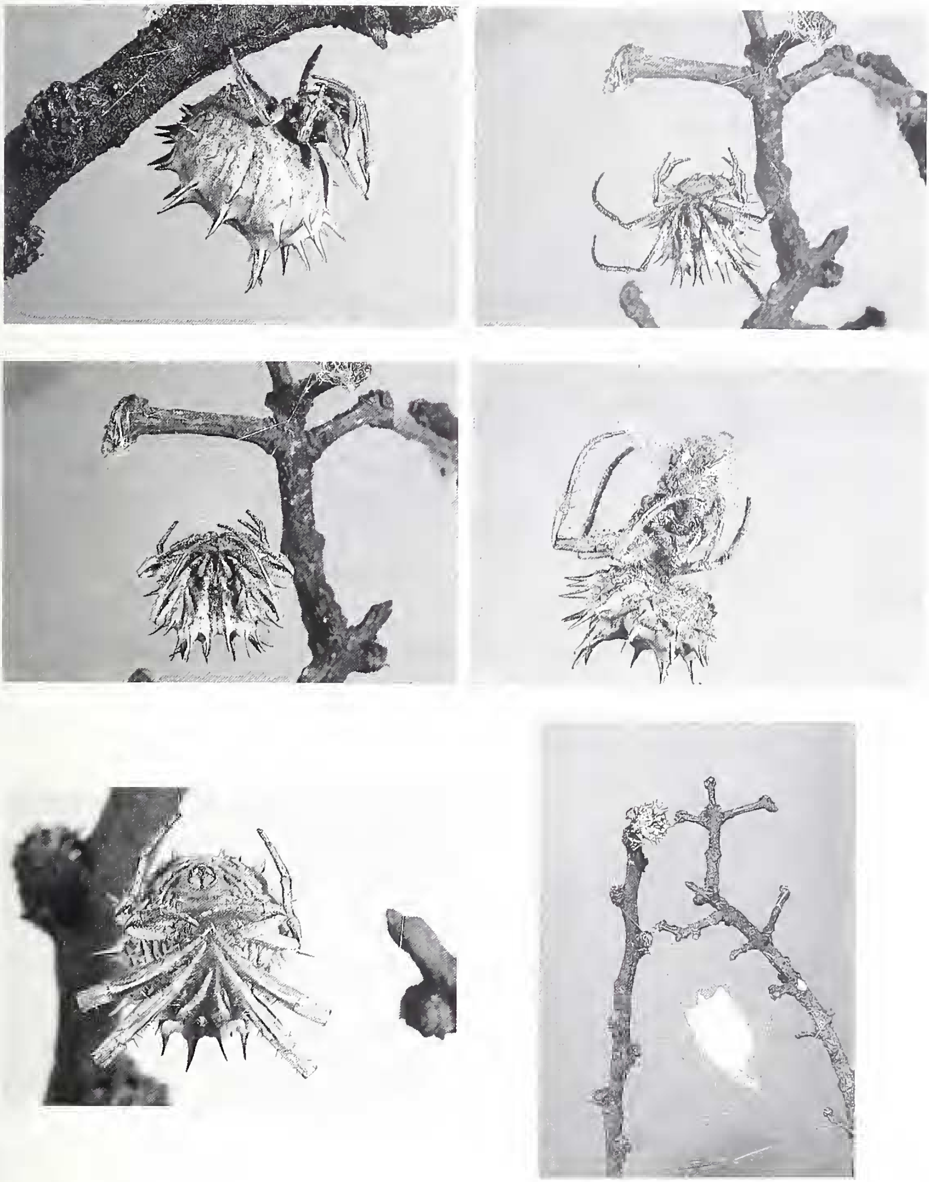
PREDATORY BEHAVIOUR

Specimens collected

On three occasions *P. tribulus* specimens were collected and observed in South Africa. The second author collected a mature female in Princess, Roodepoort in 1976 and an immature female at the Witwatersrand National Botanical Gardens in Roodepoort, in February 1991. The first author collected an adult male and female and a juvenile in Pretoria, in December 1992. On all three occassions the vegetation type they were collected from was low grassveld/shrub. Observations were made on their behaviour after being placed on twigs positioned in sand in large containers covered by a plastic dome. The dome could easily be removed to facilitate observations and photography. The spiders were regularly provided with moths and the twigs sprayed with water. When they died the specimens were deposited in the National Collection of Arachnida (NCA), Plant Protection Research Institute, Pretoria.

Habitat

The adults collected in Pretoria were taken from *Lippia rehmannii* Pearson which commonly grows in that area. The seedheads of the plant are globose and carry conspicous spiked bracts which closely resemble the abdomen of *P. tribulus*. *Pycnacantha* are recognized by their cream to yellowish-brown subglobose abdomens, which are covered with numerous (± 50 in *P. tribulus*) closely set, sharply



1 4

2 5

3 6

FIGS 1–6

1. *Pycnacantha tribulus* female in diurnale resting position; 2. *Pycnacantha tribulus* female suspended from trapezium web; 3. Female suspended in web, in waiting position; 4. Female with front legs spread to catch approaching moth; 5. Female hanging in web with moth; 6. Female with egg sac.

pointed protuberances (Fig. 1). The specimens from Roodepoort were collected from *Cirsinu vulgare* (Savi) Ten. and *Trimnfetta sonseri* Ficalho & Hiern, both plants characterised by globose, spiked seedheads. *Pycnacantha dinteri*, collected in Namibia from *Tribulus murex* Schltr. by MEISE (1932) similarly resembles the fruit in body shape and colour. The spiders probably use the plants for protection when at rest during the day.

VAN VUUREN (1981) from Cradock in the Eastern Cape, reported on *P. tribulus*. A female was collected from a twig about 15 cm above the ground on a woody bush. The locality data (n = 8) of *P. tribulus* in NCA indicate that they are very rare spiders and that they occur mainly in grassland with a low shrub cover.

Diurnal cryptic behaviour

Spiders were inactive during the day which they spent on the twigs. The legs were drawn in around the body, and the longer front legs were held close together on each side of the body, positioned at an angle of 45° to the sides with the patella protruding upwards (Fig. 1). The same positioning of the legs was reported by VAN VUUREN (1981) in the specimen from Cradock.

Prey catching

The following observations were made on several occasions of the adult female after a few tropical warehouse moths, *Ephestia cautella* (Walker), were released into the container. At dusk, or shortly after dark, the female became more active, moving around on the twig. No functional web was spun. Only a few strands of non-viscid threads were produced to form a U-shaped suspension web (Fig. 2) with a few thin, horizontal threads in between. The bottom part of the U was formed by the weight of the spider's body pulling the thread taught with the hind legs. Depending on the positioning of the hind legs, the bottom part averaged 0,93 mm in length. The side threads are twice as long, on average 1,86 mm.

The front legs are fairly robust and the first and second pairs are much longer than the posterior pairs. The inferior surface of metatarsi I and II are provided with two parallel rows of setae. With the fourth pair of legs holding onto the threads, the female suspended herself head down with legs I and II partially crossed (Fig. 3). When disturbed, the female immediately returned to the twig. When the female became aware of a moth, the front legs were spread wide apart (Fig. 4). When a moth approached in flight, it was seized with the front legs. The moth was first grasped with legs I and II and the spider appeared to bite the nearest or most accessible part of the body. Thereafter the prey was wrapped in silk with the spider still hanging from the web holding on with the front legs (Fig. 5). Swatches of silk were used while legs III and IV rotated the prey. Feeding then commenced. The remains of the prey were then cut loose and dropped to the ground. After feeding the spider was usually covered with the loose moth scales. This prey-catching sequence was repeatedly observed and filmed. Similar behaviour was exhibited by the immature spider but not by the male, who was never observed feeding. After a few weeks in captivity the female grasped moths from tweezers. House flies were also introduced but were never accepted as prey.

Similar behaviour was observed for the immature specimen collected in Roodepoort. The spider was placed in the evenings under a light, with the plastic dome removed. Moths attracted to the light were preyed upon. Any other insect that landed on the silk threads or introduced were rejected by the spider. The movement of large moths in flight, caused the spider to make a swinging motion with her body.

Van Vuuren (1981) reported that a female of *P. tribulus* occasionally suspended herself from a single U-shaped thread, i.e. without the crossbeams or stabilizers, or only spun them later in the evening. The swinging motion was also observed. This probably assisted the spider in catching moths in flight. No other prey was accepted. A fly placed on the suspension web was investigated but immediately removed from the web with the front legs. The production of a single thread and the swinging motion were only observed in the juveniles during the present study.

Due to the number and variety of moths captured and their behaviour to feed on every moth captured immediately rather than to store the prey for later feeding, gave the impression that no pheromones are involved in attracting only male moths. However, if more specimens become available this aspect will be investigated further.

LIFE HISTORY

The female produced a total of three egg sacs at intervals of about two weeks. The egg sacs were suspended one above the other between the twigs. The egg sac was large, compared to the female (Fig. 6), and consisted of strong smooth yellow silk threads on the outside while the eggs were cushioned on the inside by loose fluffy silk. The egg sac is longer than wide. The anterior part of the sac is slightly wider and provided with three protuberances. Owing to the long incubation period (three months), the first egg sac was opened prematurely in June and 34 second instar spiderlings emerged. They were fully developed, shiny dark brown in colour with reddish orange spots but without tubercles. The spiderlings remained tightly grouped in the vicinity of the egg sac. After the second ecdysis primordial tubercles became apparent. The small spiders were presented with moths and in 80% of the instances the prey was accepted. Frequently more than one spider fed on the same moth. They were frequently observed during the day, suspended from a short silk thread, just below a twig, swinging in the air. No mature males emerged from the egg sac as observed in some *Mastophora* and *Dicrostichus* species. The eggs in the other two egg sacs did not developed.

DISTRIBUTION

The genus *Pycnacantha* Blackwall comprises four African species. The known distribution of the genus is patchy. It is recorded only from Madagascar, South Africa, Namibia and Cameroon (Meise 1932).

TAXONOMIC NOTES

Simon (1895) grouped *Pycnacantha* as well as *Cyphalonotus* Simon, *Homalopoltys* Simon, *Kaira* O.P.-Cambridge, *Poltys* C.L.Koch *Ideocaira* Simon and *Micropoltys* Kulczynski in the tribe Poltyeae. Little is known about the behaviour of most of these genera. Stowe (1986) observed that species of *Poltys* spin a dense orbweb with closely spaced spirals which enable them to capture large numbers of moths. The prey-capturing technique of *Kaira* (Stowe 1986) and *Pycnacantha* is very similar. Although certain behavioural aspects differ, the basic method of hanging upside down beneath a suspension web and catching moths that fly into a basket formed by their legs is very similar. They differ in that *Kaira* produces a sex pheromone to attract male moths. Several moths are killed and wrapped before feeding commences, probably because the moths they prey on are active for a relatively brief period each evening.

Eberhard (1980) and Robinson (1982) speculated that the Cyrtarachneae, Mastophorinae and Celaenieae form a monophyletic group sharing synapomorphies such as adhesive threads, a pungent odour when disturbed, tough outer layer of egg sacs, accumulation of egg sacs side by side, mature males emerging from egg sacs, production of moth-attracting pheromones and the bending of leg I and II when resting. Stowe (1986) does not consider all of these characters useful synapomorphies. He provisionally agreed that Cyrtarachneae and Mastophorinae descended from a common ancestor, but expressed doubt about the inferred close relationship of the Celaeniae.

Kaira lacks all but two of the characters listed above. Stowe (1986) concluded that they are only distantly related to the Mastophorinae, having evolved the ability to attract moths independently from members of that subfamily. This probably also applies to *Pycnacantha* which lacks all but one of the synapomorphies listed above. A comparison of morphological characters (Levi 1993) of *Kaira* and *Pycnacantha* support their placement in the same tribe.

CONCLUSION

Few araneids have been studied extensively and behavioural observations of spiders have lagged behind taxonomic descriptions. This is particularly true for nocturnal species of the family Araneidae. A number of recent studies have shown that behavioural patterns can provide useful information on relationships and classification. The more characters used in constructing a system of relationships the greater the likelihood that the results will be correct (Eberhard 1981*a*).

Of the five tribes of Araneidae known to contain species that are able to construct specialized webs to catch moths about 50 species in 14 genera are known to occur in the Afrotropical Region. At present the behaviour of only two species are known. More information on the behaviour of African araneids could contribute to a better understanding of relationships and prey utilization.

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